OBSERVATIONS OF *XENORHYNCHIUM NITIDULUM* (FABRICIUS) (HYMENOPTERA, EUMENINAE), A PRIMITIVELY SOCIAL WASP

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Introduction

Until recently primitively social wasps, with more than one female sharing a nest but without a reproductive division of labor, were considered rare. For many years, the only such wasps known were the five species cited by Wheeler (1928) in his classic book on the social insects. More primitively social wasps are now known (for a partial list see West-Eberhard, 1979). It is clear, however, that many more remain to be discovered, and information on the biology of primitively social species is still scarce. It therefore seems worthwhile to report the following brief notes on *Xenorynchium nitidulum* (Fabricius), a primitively social wasp found in India. The observations reported here were made on nests collected in the village of Janla, Puri District, Orissa (about 20 degrees N.Latitude) in November, 1979. *X. nitidulum* is widely distributed in India. Vecht (1963 p. 112) cites Dover and Rao (1922) as recording this species from Calcutta, Pusa, Bangalore, Lucknow, Kashmir, and Lahore (Punjab).

Nest Structure and Contents

Xenorhynchium nitidulum builds a nest consisting of several barrel-shaped mud cells coated with an amber-colored substance that is sticky when fresh, and that later forms a hard lumpy coating. This coating strengthens the rather fragile mud walls of the cells which are only 0.25–0.5 mm thick. It may also afford some protection against insect predators and parasitoids, as further discussed below. Horne (1870) and Dutt (1912) report that the gummy substance comes from the trees *Ficus religiosa* and *Acacia catechu.*

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The largest recorded nest of *X. nitidulum* contained 25 cells (Dutt, 1912). Two inhabited nests collected in Janla (N1, N2) contained 14 and 2 cells, respectively. Cells are 17.0–22.0 mm long and 12.0 mm wide at the center, with the mouth 5.0–7.0 mm in diameter. The cells are arranged in a cluster, with the foundations of the first three or four cells usually attached to the underside of a horizontal surface, such as the ceiling of a man-made structure. The first cells are inclined with their axes at about 80° from the attachment surface, and additional cells are aligned parallel to them, but with their foundations displaced slightly so as to be free of the substrate. All of the cell entrances face in the same direction; they open upward when the nests are attached to a wall.

The two inhabited nests were located on the ceiling of a dark room. Abandoned nests were found in similar sheltered situations, e.g., in the rooms and stairways of an abandoned house in the same village. The species had evidently been common in ancient abandoned Jain caves at Udayagiri, near Bhubaneshwar, but the walls and ceilings of the caves had recently been cleaned, leaving only gummy outlines of where the bases of cells had been attached. While searching the caves for nests, I noted several black female wasps the size of *X. nitidulum* sitting inside mud and gum-lined holes in the cave walls, facing outward as does this species in the cells of the nest (see below). Several such holes were sealed with mud and a gummy substance. This species thus may sometimes inhabit pre-existing holes; but I was unable to collect specimens of the hole-occupying wasps for certain identification.

When collected on 24 November nest N1 contained 11 closed cells (sealed with mud overlain with gum) and three open cells. One open cell was empty, and a day later I found the two other open cells contained a single lepidopterous larva, 7.5 mm long, without an egg; and a mature wasp larva in the process of spinning a cocoon within the cell. N2 consis~~ted of~~ two cells, one of them empty but lined with a silky material as if it had already produced an adult, and the other incomplete (in the process of construction). These two nests were only about two feet from each other in the same room. I kept nest N1 in a jar to see what would emerge from the eleven sealed cells. They produced four female and three male *X. nitidulum* adults, and three males of the cleptoparasitic wasp *Stilbum cyanurum splendidum* (Chrysididae). The three parasites, and one male and one female *X. nitidulum* emerged before 26 December. The remaining

X. nitidulum adults emerged in the following order (with time elapsed since nest collection given in parentheses): male (32 days), female (42 days), female (52 days), male (60 days), female (61 days). When one of the closed cells produced nothing after more than three months I opened it and found that it contained two desiccated objects that appeared to be caterpillars but that were in such poor condition that they could not be identified.

An abandoned nest (N3) was also collected. It consisted of 11 cells, six of them sealed with mud and gum prior to abandonment. Two sealed cells contained chalcid parasites (five in one cell and seven in the other). A small larva was found in each of two open cells, and a large larva was in a sealed cell with three prey. Of the remaining cells, two were damaged by collection and the contents lost; two had been secondarily occupied by some other species (one was sealed with a thick mud plug, and one contained a vacated puparium); one contained a nearly mature male; and one open cell contained a desiccated adult male.

N1 was inhabited by two adult females when captured. A third female caught entering the room with prey was probably associated with N1 which had the only cells in the room containing prey or larvae. It is also possible that this female was carrying the first prey to the empty cell of N2. Thus N1 was attended by at least two and probably three females. Another female, netted as she entered the room with mud, was probably building the incomplete cell of N2, since it was the only cell of the two nests present containing freshly applied mud. A fifth female, collected later by the owner of the room, was reported by him to be associated with the site of N2, but the two nests were so close together that this was difficult to confirm.

The five females associated with these two nests were dissected. All of them had sperm in the spermathecae (were mated). The spermatheca of one of the females known to be associated with N1 was brownish in color, and her ovary contained many yellow bodies—both often characteristics of old female wasps. The female sitting in the empty cell of N1 when it was collected had two well developed eggs in her ovary (measuring 2.5 mm and 2.0 mm in length). This was the most developed ovary of the five females. Three of the females had just one large egg each; and one, evidently a young female judging by the light color of her abdominal apodemes (see Richards, 1971), had undeveloped ovaries (no visible oocytes).

The Behavior of the Adults

Adults of both sexes sit facing outward in empty cells on the nest. It is not known if they likewise sit in cells containing immatures or prey, but seems likely that they do. There is no doubt that the female wasps defend the cells in which they sit. When I touched nest N1 while preparing to collect it to my great surprise I was immediately stung by a female sitting in a cell. Close examination of the position assumed by such females revealed that they sit curved in the shape of a letter "C," so that both head and abdomen point outward at the mouth of the cell. When approached, the head is slightly retracted and the abdomen thrust forward to sting. I know of no published records of defensive stinging by Eumeninae or other solitary aculeate wasps. I have been stung by airborne females of *Zethus miniatus* while tampering with their nests, but those females, which also sit facing out of brood cells, withdraw into the cells when threatened rather than coming forward to sting. One *X. nitidulum* female also stung me readily when accidentally touched in the collecting net.

Another unusual feature is that these wasps either sometimes begin provisioning before ovipositing, or they store prey in empty cells, as evidenced by the broodless cells containing prey on N1. All vespoid wasps oviposit in an empty cell and begin provisioning later, often after the egg hatches (Evans and West-Eberhard, 1970). However, Isely (1913) found that some Kansas eumenines deposit a few prey in the cell prior to oviposition. This point merits further study in the case of *X. nitidulum,* since I saw only one (eggless) cell being provisioned.

The contents of N1 suggest that vacated cells are reused. The three cells of N1 that were open when collected were among the older (uppermost) cells of the nest; one was being provisioned, and one contained brood. Females may reuse vacated cells when they are available, and build new cells only when they are not. On N1 and N2 there were five adult females and only four vacated empty cells; in that situation one new cell had been initiated.

The fact that a large larva was found in an open cell may indicate progressive provisioning of the young. However, one of the closed cells of the abandoned nest (N3) contained the remains of a large larva and three uneaten prey. Perhaps *X. nitidulum,* like the primitively social eumenine *Zethus miniatus* (personal observation), engages in what Evans (1966) calls "truncated progressive provision-

ing," in which several prey are brought to the cell in quick succession when the larva is nearly grown, and the cell is then sealed.

The chrysidid wasp, *Stilbum cyanurum,* probably opens an oviposition hole in the cell wall after the host cells are sealed (see Bequaert, 1918; Iwata, 1976, p. 57). The sticky covering of *X. nitidulum* nests may provide some protection against the attacks of such intruders.

Even though brief, these observations show that *Xenorynchium nitudulum* should be classified as at least "primitively social," defined as nest-sharing without a reproductive division of labor. Of the five females associated with the two inhabited nests of this study, all were mated, and all except a very young (probably recently emerged) individual had developed ovaries. Of the five females, three were known to be active caretakers of the nests; one was observed provisioning, one carrying mud, and one defending the nest by stinging an intruder. The combination of dissection and behavioral data indicates that the females associated with the nests were not simply resting there, but active residents of shared nests.

A male which emerged in captivity attempted copulation on the nest with a female which emerged a day later. Each time the male's gentalia were extruded he placed his mouthparts just behind the female's head and bit at her mildly. When mounted the male periodically fanned his wings and while doing so lowered his antennae against those of the female, as in *Polistes* and some other vespoid wasps (see West-Eberhard, 1969 and references therein). Intromission was not observed. These two adult wasps fed on raisins and water, and survived for several days in the jar containing the nest. Although they wandered about the jar during the daytime, at night the female always sat inside one of the empty cells (not always the same one) facing out. The male was less consistent in his sleeping habits, sometimes sitting in a cell facing inward, once facing outward. He usually spent the night sitting on the surface of the nest rather than in a cell.

Folklore

Xenorhynchium nitidulum is a common wasp in Orissa and other parts of India (see Vecht, 1963). Because of its habit of building nests on human habitations, it is familiar to the residents of the region. Mrs. Rukmini Patnaik, whose family is from a village near

Janla, informed me that *X. nitidulum* is known in the Oriya language as "lakha bhanra" ("the lacquer bee"), and is popularly distinguished from species building plain mud nests ("matti bhanra," or "mud bees"). Some people believe that pregnant women in homes inhabited by "lacquer bees" are destined to give birth to boys, whereas "mud bees" forecast the birth of a girl.

Summary

The Indian eumenine wasp *Xenorynchium nitidulum* is at least sometimes "primitively social" in that more than one adult female participates in brood-rearing on a single nest. Examination of nest contents and dissection of females indicate that cells are reused and larvae are progressively provisioned, at least in the early larval stage. Females sit facing outward in uncapped cells and sting defensively by bringing the tip of the abdomen forward without coming out of the cell. The gummy coating of the outside of the thin mud cell walls may provide some protection against the parasitoid *Stilbum cyanurum splendidum* (Chrisydidae), which emerged from collected nests. Courtship behavior was observed in the laboratory. *X. nitidulum* is known as "the lacquer bee" in Orissa, and is popularly believed to be useful in predicting the sex of unborn children.

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